thetech.com

Volume 142, Number 14



WEATHER, p. 2 Chance showers SAT: 79°F | 57°F

Mostly sunny

Thursday, July 7, 2022



Kyiv mayor Vitali Klitschko and his brother Wladimir Klitschko speak to the press at the Madrid Summit about Ukraine, calling on NATO to take action against Russia.

Ukraine makes surprise appearance at Madrid **NATO Summit**

Klitschko Brothers call for 'whatever it takes' to stop Russia

Bv Selena Zhang and Daniel Wu

Kyiv mayor Vitali Klitschko and his brother Wladimir Klitschko made an unannounced appearance Tuesday evening at the NATO Summit in Madrid.

Wladimir Klitschko criticized NATO for deflecting from the war in Ukraine: "Part of this NATO conference is climate. You cannot imagine what is going on with the modern nation in Ukraine. Nobody cares about anything like that in Ukraine during the war. We don't have COVID. We don't have any rules in Ukraine but only one rule: the broken law of war."

The Klitschtkos' appearance comes on the heels of the opening Public Forum, in which NATO Secretary General Jens Stoltenberg labeled climate change as the "defining challenge of our time."

Klitschtko responded that "priority and unity around Ukraine" is the 'key for peace back in Europe."

He outlined the threat to NATO with certainty, saying "Wake up guys! This is happening now. You're gonna he next This is gonna he knocking on your door, just in the blink of an eye. As Russian propaganda already announced, 'we will continue rolling on."

Klistschko warned that Russia's actions could be a slippery slope and that "Russia's going to launch something new." He proceeded to say that "for real, the next world war is going to happen eventually. So let's stop it in Ukraine." He indicated NATO's response would send a broader signal: "There is international law. It needs to be respect[ed]."

Klistschko asked member states to fight with "whatever it takes," and said that Russia "needs to be stopped now" whether it takes troops, defensive weapons, or offensive weapons.

Although expected to announce a significant wave of aid in the Comprehensive Assistance Package to Ukraine, NATO has been wary of taking direct action against Russia and instigating a larger war. In particular, Zelenskyy has been calling for NATO to impose a no-fly zone over Ukraine since near the start of the war, but NATO officials have demurred on taking concrete

Klitschko's comments follow the G7 statement released June 27 affirming that the leaders of the G7 will "stand with Ukraine for as long as it takes.

Editor's note: All quotes in this article from the Klitschko Brothers' appearance are attributed to Wladimir Klitschko, though both brothers did speak to the press.

The last day to petition to take August or September ASEs is July

MIT personal certificates expire **July 30.**

The last day of classes for Summer Session is Aug 12.

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Finland, Sweden, and Türkiye sign NATO membership Agreement

Stoltenberg: This memorandum is 'exactly the opposite' of what Putin wanted

By Selena Zhang and Daniel Wu

The foreign ministers of Türkiye, Finland, and Sweden have signed an agreement on the entry of the latter two countries into NATO, Secretary General Jens Stoltenberg announced in an impromptu press conference

Tuesday.

Stoltenberg called NATO's open door policy "a historic success" and stated that "we are demonstrating that NATO's doors are open, NATO's doors are open."

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XKCD

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How we can return to space economically and efficiently. SCIENCE, p. 5



LICK IT GOOD

Nothing is better than summer and ice cream. ARTS, p. 4

2022 STRATEGIC CONCEPT

NATO aims to increase strength and unification

WORLD AND NATION, p. 3

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NATO Secretary General opens historic Madrid Summit with public forum The forum focused on climate change, but simultaneously

stressed unity under threat of Russian aggression

By Daniel Wu and Selena Zhang

NATO Secretary General Jens Stoltenberg declared "Climate change is a defining challenge of our time" at the opening public forum of NATO's 2022 Summit in

Stoltenberg named NATO's first emissions targets, aiming for net zero by 2050. NATO civilian and military authorities will gather to establish an energy transition plan to be announced next year.

As he laid out NATO's climate change agenda, Stoltenberg emphasized its link to the war in Ukraine. "If we fail to preserve peace we also fail to fight climate change," Stoltenberg said. He stated that "the war in Ukraine shows the danger of being too dependent on commodities from authoritarian regimes," and said that Russia used its oil and gas exports as a "weapon of

In his opening remarks, Stoltenberg stressed the need for unity under the threat of Russian aggression. He pointed out that "it is in our interest to support Ukraine," and that "the world of NATO allies will be more insecure if Putin wins this war."

To this end, NATO members plan to finalize the Comprehensive Assistance Package to Ukraine at this summit. This package will commit NATO to providing a sweeping set of military and civilian equipment and aid to support the Ukrainian fight against Russia.

Summit Agenda

In Madrid, NATO will update its Strategic Concept for the first time in over ten years. The Madrid Strategic Concept will underpin NATO initiatives for the next decade, and is expected to be highly influenced by the war in Ukraine, Russian aggression in the Arctic, and Chinese expansion in the South China Sea.

This marks a shift from the last Strategic Concept, released in 2010. The previous Concept referred to Russia as a "strategic partner," and made little reference to China and the Pacific. The Madrid Strategic Concept is expected to designate Russia as a security threat: NATO will also release a written policy on China for the first time.

Finland's and Sweden's applications to join NATO are also a primary point of discussion. World leaders will attempt to reach an accord with Türkiye, the primary opponent to the accession of these two countries.

This summit in Madrid marks the 40th anniversary of the accession of Spain into NATO, and immediately follows the G7 meeting from June 26-28.

World leaders from over 35 NATO member and affiliate nations are in attendance at this annual summit, which ends on June 30. The summit schedule can be found here (https://www.nato.int/cps/en/ natohq/events_196720.htm).



NATO Secretary General Jens Stoltenberg speaks at the opening public forum of the Madrid Summit.

NATO Membership, from Page 1

Finland and Sweden are not currently NATO member states, but have been seeking membership following the Russian invasion of Ukraine. The two nations formally applied for membership mid-May.

Progress on Finland's and Sweden's NATO bids was a primary goal of this summit; the agenda emphasized that "as authoritarian regimes contest core principles for our security, the Alliance must work even more closely with like-minded countries and organizations."

According to NATO's Accession Protocol, the entry of a country into the alliance requires unanimous approval from all existing member states; Recep Tayyip Erdoğan, the President of Türkiye, had been vocal in his opposition to Finland and Sweden's entry to the association.

Türkiye's primary objection stemmed

from Finland's and Sweden's resistance to extraditing insurgent fighters from the Kurdistan's Worker's Party (PKK). While the US, EU, and Turkey list the PKK as a terrorist organization, several PKK affiliates were instrumental to the fight against ISIS, and are not considered terrorist groups.

On Tuesday evening, after weeks of talks, the three countries reached an agreement.

"Our foreign ministers signed a trilateral memorandum which confirms that Türkiye will, at the Madrid Summit this week, support the invitation of Finland and Sweden to become members of NATO," Finnish President Sauli Niinistö said in a statement June

"Our joint memorandum underscores the commitment of Finland, Sweden and Türkiye to extend their full support against threats to each other's security. Us becoming NATO allies will further strengthen this commitment," Niinistö added. Meanwhile, Ankara announced that it "got what it wanted"

from the talks. Stoltenberg refrained from outlining the precise agreement the countries had come to on handling extradition requests, but reaffirmed NATO's declaration of PKK as a terrorist organization. "Finland and Sweden as NATO allies regard PKK as a terrorist organization," Stoltenberg stated. He added that "terrorism is something we have to fight in all its manifestations" and that the joint memorandum "reflects that reality."

Stoltenberg proclaimed that the memorandum is "exactly the opposite of what President Putin wanted." With Sweden's and Finland's entries into NATO, the land border between Russia and NATO territories would more than double - from around 750 miles to approximately 1,600 miles. Since NATO forces can be freely deployed in NATO countries, this amounts to a significant increase in the pressure NATO may exert on Putin.

Things are getting pretty heated

By Phoebe Lin

A heat dome is building over the southern Plains as much of Oklahoma, Tennessee, and Missouri are expecting tripledigit temperatures for the end of the week. While the heat will worsen dry conditions in the West, it will interact with humid conditions in the Northeastern to continue bringing severe thunderstorms to the Central and Eastern US. Hail the size of golf balls and wind gusts up to 90 mph have already been ence the trailing effects of the recent derecho that swept through South Dakota and Iowa earlier this week.

The combination of heat and humidity can be deadly, especially at this time of year. Try to stay indoors in cool places when possible. If you have the time, consider dropping by the beach to catch some of that refreshing sea breeze!

Extended Forecast

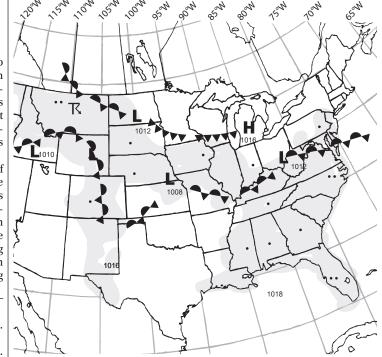
Today: Partly sunny. High around 77°F (25°C). East winds around 8-11 mph.

Tonight: Partly cloudy. Low around 63°F (17°C). South winds around 5-7 mnh.

Friday: Chance showers. High around 83°F (28°C) and low around 66°F (19°C). Southwest winds around 9-12 mph. Saturday: Mostly sunny. High around 79°F (26°C)

around 12-15 mph. **Sunday**: Sunny. High around 78°F (26°C) and low around 56°F (13°C). North winds 8-11 mph.

and low around 57°F (14°C). North winds



Situation for Noon Eastern Time, Thursday, July 7, 2022

Weather Systems	Weather Fronts	Weather Fronts Precipitation Symbols		/mbols	Other Symbols	
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Stoltenberg discusses global food crisis due to war in Ukraine at closing press conference of Madrid Summit

Many NATO members, including Türkiye, Greece, and Romania have already taken action

By Sophia Wang

NATO Secretary General Jens Stoltenberg summarized important developments in the Alliance's goals for the near future in his closing press conference at the Madrid Summit June 30.

Stoltenberg discussed the global food crisis caused by the Russian naval blockade of Black Sea ports. "The impact is severe, including on some of the world's most vulnerable people," he said, adding that food prices are hitting "record highs" so "Allies discussed their efforts to mitigate the crisis and get grain out of Ukraine, by land and on sea."

Since its initial invasion of Ukraine in February, Russia has implemented a total blockade on all Ukrainian ports. The blockade has prevented Ukrainian merchant ships from entering Black Sea ports, including Odessa, thus halting the country's export of its most important good: grain. Beyond naval efforts to restrain the Ukrainian market, Russia has repeatedly bombed grain storage facilities near the Black Sea.

Many NATO members are already taking action.

Stoltenberg reported that "Türkiye plays a key role in trying to facilitate some kind of agreement. Also, Greece announced that they are ready to make available ships to get grain out of Ukraine, and other Allies are involved in different diplomatic efforts to get some kind of agreement to allow ships to sail with wheat over the Black Sea."

He continued, noting that "Romania and other countries updated us on their efforts to expand their own land capacity by railway to transport more food on land. It's very hard to compensate fully [for] what we can transport by ships but on land is also a way."

Ukraine's role in global food security has only grown in prevalence in recent years.

Considered a critical breadbasket of the world, Ukraine produced 10% of global wheat exports in 2021, as reported by the United Nations Food and Agriculture Organization. Ukraine is the fifth largest exporter of wheat, and the world's leading exporter of meal. Today, over 20 million tons of grain are in storage facilities across the landlocked country.

U.N. Secretary General António Gutterres said May 18 that the war in Ukraine could push "tens of mil-

NATO unveils its 2022 Strategic

lions of people over the edge into food insecurity, followed by malnutrition, mass hunger and famine, in a crisis that could last for years.' U.N. World Food Programme head David Beasley said May 23 that "failure to open the ports in Ukraine will be a declaration of war on global food security."

The effects of the war on prices have been swift and evident. President of the European Commission Ursula von der Leyen cited rising grain prices globally — in Lebanon, bread prices have already risen by 70%. This trend is likely to continue.

Russia's control of all traffic in the Northern region of the Black Sea prevents safe commercial shipping. Ukrainian President Volodymyr Zelenskyy addressed its consequences during the Davos forum, stating, "there will be famine, there will be catastrophe, there will be a deficit, there will be a high price."

Stoltenberg said that the Madrid Summit had been a critical space for Allies to "meet and coordinate and discuss and exchange views and compare notes on the different efforts that NATO Allies are involved in to try to get more grain out of Ukraine, to get food out of

Stoltenberg: Allies 'prepared for the long haul' in war of attrition in Ukraine

NATO Secretary General Jens Stoltenberg stated NATO's position in a war of attrition on the third day of the Madrid summit, saying "it's very clear that Allies are prepared for the long haul. Wars are unpredictable, but we have to be prepared for the long haul. And that was also the clear message to all of us in the room from President Zelenskyy and our answer was 'yes, we are prepared." He added that the Ukrainians "are fighting for their independence. But they're also fighting for values which are important for NATO, fundamental for NATO: the sovereignty and territorial integrity of every nation. And therefore this matters for our security.'

The statement echoes comments Stoltenberg made early June. When visiting Washington ahead of the Madrid Summit, he declared the war to be a war of attrition and said "we just have to be prepared for the long haul, because what we see is that this war has now become a war of attrition."

Stoltenberg has repeatedly emphasized NATO's position to avoid a "full-fledged war" against Russia, providing "support to Ukraine" but remaining "not part of the conflict."

Support from NATO member states has included military and financial aid; in particular, President Joe Biden recently announced a \$700 million weapons package that would be supplied to Ukraine; the package includes advanced rocket systems and anti-aircraft missiles.

—Sophia Wang



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Solution to Internship

Solution to Research

Concept in efforts to coordinate the fight against Russia

Concept condemns Russia, cautions about China, targets a more unified and powerful NATO

By Daniel Wu

NATO Secretary General Jens Stoltenberg unveiled the 2022 Strategic Concept at the NATO Summit in Madrid earlier today. Stoltenberg declared that "We face a radical change to our security environment, and strategic competition is rising around the world."

The concept identified Russia and China as major geopolitical threats, and nuclear proliferation, cyberwarfare, and climate change as the biggest challenges of the decade.

O Strategic Concept a key document, playing a central role in informing NATO initiatives. It is updated approximately every ten years; the previous Strategic Concept was established at the 2010 NATO Summit in Lisbon.

The Strategic Concept outlines the values and priorities of NATO so as to coordinate the defense efforts of individual member states.

cept at Madrid summit.

Madrid Concept's stance on

The Madrid Concept condemns Russia's "brutal and unlawful invasion" of Ukraine, which has led to "repeated violations of international humanitarian law and heinous attacks and atrocities [that] have caused unspeakable suffering and destruction."

The new Concept states that "the Russian Federation is the most significant and direct threat to Allies' security" and says that "its coercive military posture, rhetoric and proven willingness to use force to pursue its political goals undermine the rules-based international order."

However, the Concept shies away from directly opposing Russia, stating that "NATO does not seek confrontation and poses no threat to the Russian Federation" and that "we remain willing to keep open channels of communication with Moscow to manage and mitigate risks, prevent escalation and increase transparency.' NATO's refusal to seek confrontation with Russia mirrors the feelings of citizens of NATO member

A poll of citizens of NATO member states conducted by the Pew Research Center found that "there is widespread reluctance to fulfill the collective defense commitment outlined in Article 5 of NATO's founding treaty. When asked if their country should defend a fellow NATO ally against a potential attack from Russia, a median of 50% across 16 NATO member state say their country should not defend an ally, compared with 38% who say their country should defend an ally against a Russian attack."

Shift from previous Concept

Both the previous Concept and the newly unveiled one emphasize the importance of preventing nuclear proliferation, countering terrorism, and the threat of cyberattacks.

Stoltenberg pointed out, however, that the previous Concept did not "mention China with a single word" and further stated "that Russia is a 'strategic partner.'' By contrast, the new Concept "makes clear that Russia poses 'the most significant and direct threat' to our security" and further that "China's coercive policies 'challenge our interests, security and values."

The presentation of the new Concept carried with it the announcement of significant military expansion: Stoltenberg announced that "the number of high readiness NATO forces will reach well over



BOOK REVIEW

Our Ancestors Did Not Breathe This Air: On growing up Muslim in America

Six MIT students share their thoughts on belonging, identity, love, and MIT itself

Our Ancestors Did Not Breathe This Air

Afeefah Kyazi-Syed '21, Aleena Shabbir '20, Ayse Angela Guvenilir '20, Maisha Munawwara Prome '21, Mariam Eman Dogar '20, Marwa Abdulhai '20

Beltway Editions

June 15

By Anahita Srinivasan STAFF WRITER

At the beginning of 2020, before the coronavirus pandemic upended our lives, six MIT students began sharing their poetry with each other. They had written about love and loss, about immigration and culture clashes and MIT itself. When MIT shut down in March of 2020, they continued this tradition over Zoom, taking comfort in sharing pieces of themselves with each other via the medium of verse.

And thank goodness they did, because in April of this year, they were able to publish Our Ancestors Did Not Breathe This Air, an anthology of original poetry that serves as a beautifully poignant exploration of what it means to grow up Muslim in America. Authors Afeefah Kyazi-Sved '21, Aleena Shabbir '20, Ayse Angela Guvenilir '20, Maisha Munawwara Prome '21, Mariam Eman Dogar '20, and Marwa Abdulhai '20 masterfully capture the feeling of balancing between two cultures, and they do so with humor, compassion, and

While some of the subject matter may be heavy, the anthology itself is brimming with wit and humor. A perfect example of this is Dogar's poem "Side effects of summer may include," which brilliantly encapsulates the atmosphere of summertime. The line "Cherry-stained lips on vanilla cream cones" is especially evocative. Overall, the poem is one of my favorites in the entire anthology simply because of the vivid imagery in every line of verse. Guvenilir's "Dear My Favorite Memories" features another example of the juxtaposition between heavy and light in this anthology. She recounts notable memories her friends have of her - some funny, some moving — and blends descriptions of the lighthearted moments of life with the nostalgia inherent in watching yourself grow up.

Some of the more emotionally difficult poems in the anthology center around the topics of immigration and belonging. Abdulhai's "a citizenship," for example, contains the line "you speak in the language of your colonizers from 1858," which is a beautifully succinct way of describing the conflict between the various parts of one's identity. Indeed, that is what the poem itself is about: the difficulty of reconciling traditions and customs from our heritage with those of the country in which we hold citizenship. In a similar vein, Kyazi-Syed discusses the difficulties of being both Indian and Muslim in "A Statement for the Confused." She explains how the 1947 partition, which created the separate nations of India and Pakistan based on Hindu and Muslim religious majorities respectively, had the consequence of denying her a space in which she could freely express both of these aspects of her identity.

Another poem that explores these themes is Prome's "Welcome Home," in which she recounts the tangle of emotions she feels when a TSA agent in Boston welcomes her home after landing. She explains, "I have only known a world where I am not welcome." The poem focuses on the elements of foreignness and alienation holding her back from being fully accepted whether she is in Bangladesh or in America. But the two simple words of "welcome home" promise to be the first step in her feeling that acceptance.

The anthology also does a wonderful job addressing more emotional topics namely, love. It opens with a section on mothers, specifically immigrant motherhood, and nothing sums it up like Prome's "Why I Don't Celebrate Father's Day." In the poem, Prome explains how when presented with a card for Father's Day, her father simply asked her to give the card to her mother. The poem is short — only six lines - but it serves as a profound acknowledgement of the sacrifices women in immigrant families make in raising those families. Khazi-Syed's poem "Parachute" tackles this concept from another angle; she notes the wrinkles on her mother's fingers as her mother massages coconut oil into her hair for her, and when her mother asks her when she will start taking care of herself, she finds herself wanting to ask the same question back.

Shabbir's "Aleena' isn't what I go by" is another thoughtful piece on what it means to be loved - this time through the different names she goes by. She notes that she very rarely hears her legal first name and catalogs the various affectionate nicknames she has, each of which originates from a different memory. Shabbir does a fantastic job of subtly tying the significance of these nicknames to the deeprooted love that she is a recipient of.

Ultimately, Our Ancestors Did Not Breathe This Air is a fantastic exploration of identity and belonging. The authors manage to tackle difficult, often sensitive, subjects with uncommon wisdom and insight, making the anthology a pleasure to

J.P. Licks

Ice cream, \$

150 Charles Street

Boston, MA 02114

11 a.m.–11 p.m. Daily

banana, and orange. While I am not su-

per enthusiastic about sorbets, I felt that

this was one of the best sorbets I've ever

had due in large part to the Kool Aid fla-

vor. However, if I had to pick between the

vegan options, I would choose the Cookies

ies 'n' Cream has been a long time favorite

The dairy-containing version of Cook-

'n' Cream dairy-free ice cream.

RESTAURANT REVIEW

The perfect treat for Boston's summer

J.P. Licks's new ice cream flavors are worth melting for

By Vyshnavi Vennelakanti

J.P. Licks announced the release of five new ice cream flavors for Summer 2022. Founded in 1981, J.P. Licks has boasted some of the best ice cream in Massachusetts with over 20 flavors including several dairy free ice creams and sorbets. This summer, J.P. Licks has upped their game with the release of Unicorn Crunch, Cinnamon Toast Crunch, and Chunky Peanut Butter Chocolate Covered Pretzel flavors as well as Sharkleberry Fin Kool-Aid sorbet and Cookies 'n' Cream dairy free ice

Given the vast selection, I was both excited and skeptical to taste the new flavors.

J.P. Licks also released two vegan flavors, a sorbet and a dairy-free ice cream. The Sharkleberry Fin Kool-Aid sorbet features the more dominant Kool-Aid flavor with a subtle tropical twist of strawberry,

Ultimately, I was pleasantly surprised to discover that all the flavors were amazing, with Unicorn Crunch reigning supreme. Unicorn Crunch features bright pink cake batter swirled with multi-colored sequin candies. Speaking to the motivation behind this brilliant flavor, J.P. Licks's founder Vincent Petryk said, "I have a 26 yearold child who still loves unicorns. I was thinking about her one day and thought 'I should make a unicorn flavor." Trust me when I say this flavor is as delicious as it is colorful.

And for those of you who love cinnamon, you will be delighted with J.P. Licks's Cinnamon Toast Crunch ice cream. I myself was never a huge fan of cinnamonflavored ice cream. However, I fell in love with this flavor, which contained Cinnamon Toast Crunch cereal pieces without the cinnamon taste being too strong. Talking about this ice cream, Petryk mentioned that he started eating Cinnamon Toast Crunch cereal and thought it would make a good ice cream flavor. He said, "You're already putting cereal in milk, so t's almost like a no-brainer!"

While each ice cream flavor is unique in its own way, the idea of having dark chocolate covered pretzels and roasted, salted peanuts in the Chunky Peanut Butter Chocolate Covered Pretzel ice cream was particularly innovative. As a native of Philadelphia, Petryk drew inspiration from his hometown: "Philadelphia is a place where pretzels are kind of a big thing." He continued, "When I was a boy, they used to serve ice cream for a penny and put a pretzel stick in your cup of ice cream. Since I was a child, I became a fan of chocolate covered pretzels, and one thing led to another, and eventually we ended up with this flavor!"

at J.P. Licks. Petryk explained that it was indeed the popularity of the regular Cookies 'n' Cream dairy ice cream that motivated the company to come up with a dairy-free version that would let vegans enjoy the flavor too. Petryk further talked about the growing popularity of vegan ice cream and said that we could "expect more vegan flavors in the coming days." The vegan version of the Cookies 'n' Cream flavor combines dairy-free coconut-oat ice cream with lots of crushed cookies and tastes no different than its dairy counterpart. This flavor packs all the deliciousness of the Cookies 'n' Cream dairy ice cream and presents it to the vegan community. In fact, this is

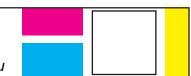
Overall, I would highly recommend visiting a J.P. Licks store to check out the newly released ice cream flavors right away. And, remember: "Summer would not be summer without ice cream!"

one of Petryk's favorite ice cream flavors

among the new releases.



The Sharkleberry Fin ice cream from J.P. Licks' new summer releases



Thursday, July 7, 2022

Nuclear thermal propulsion: a key technology for space exploration

The history and future of astronautic nuclear technology

By Codrin Paul Oneci

Over the past few years, organizations and companies including NASA, the U.S. Department of Energy, SpaceX, and the International Atomic Energy Agency have expressed interest in using nuclear technologies to make space exploration more efficient and economical. In particular, nuclear thermal propulsion (NTP) is emerging as a potentially key technology for transporting large masses from Earth to various positions in the solar system, while surface power systems using nuclear reactors could be used to provide energy to the first human inhabitants of Mars.

NTP is not a new technology: it was largely developed in the 1960s during the Space Race, culminating in the successful development of the Nuclear Engine for Rocket Vehicle Application (NERVA). The principle behind all NTP systems is the same: nuclear fission is used to heat helium or hydrogen to temperatures of about 2,200-2,800 Kelvin, accelerating these gasses to produce thrust. In the case of NERVA, the design was similar to that of a miniaturized nuclear fission reactor, containing components made of graphite and beryllium oxide and a liquid hydrogen-based coolant in the rocket propellant. These atoms, which have a low atomic mass, are used in thermal propulsion because they have the highest associated specific impulse — the ratio between the exhaust velocity of the particles and the gravitational field intensity at sea level. Essentially, higher specific impulses result in higher thrust and better mass efficiency: for the same thrust, the propulsion system mass is lower.

In 1973, NERVA was capable of generating significant amounts of aggregated power of exhaust particles, with a specific impulse more than double that of chemical rockets and a particle exhaust velocity close to 8,000 meters per second, almost double the particle velocity in chemical engines. NERVA had a thrust comparable to that of chemical rockets, but the main advantages of the technology were its high specific impulse and energy density. For maneuvers involving large specific transfer impulses, such as Earth-Mars missions, the maximum allowed mass of a spacecraft is the primary technical constraint, and at that point NTP results in higher economic efficiency for reaching the same transfer objective.

The operating parameters and performance of NERVA are considered state-of-the-art even in modern-day designs and illustrate the benefits of nuclear propulsion over chemical rockets: more compact energy sources and higher particle exhaust velocities. While the large size of NTP sys-

tems and inherent radioactive nature of ejected matter makes them unusable on Earth, they are a strong option in space conditions.

However, after the success of the Apollo program and immediate public image benefits of its success in the Space Race, the United States government decided not to invest further in these projects. Politicians were no longer interested in investing in a program relevant for a manned mission to Mars, and although the technology had been developed and was ready to use, there was no public interest in continuing research in the field or making commercial use of it. Research and development of NTP was stagnant between the end of the Space Race and the 2010s.

Today, 50 years later, the landscape of space exploration is very different, as both China and Russia are willing to spend national resources to achieve strategic superiority in astronautics and the development of space systems, including preparation for the economic exploitation of space and resources in it. Economic competition over the last decade has also generated more interest in the field, and organizations and companies across both the U.S. and Europe have decided to invest more in it, with positive effects on the development, both physical and conceptual, of many technologies — including NTP.

Given the fact that NERVA weighed about 18 tons and Starship, the largest spacecraft currently produced by SpaceX, is capable of lifting more than 100 tons of payload to low earth orbit, it is evident for many specialists that we are currently capable of transporting such large propulsion systems in a single trip. Moreover, there exists the possibility of actually assembling large space structures while in the Earth's orbit, or in nearly constant gravitational potential regions — space where the gravitational field intensity is close to zero, with almost no gravity observed.

Until we see NTP systems running in space, we may first witness the deployment of other nuclear technologies, like nuclear electric propulsion systems, which complement current work by NASA to miniaturize high-power nuclear systems for space missions. Using electromagnetic fields to accelerate ions, these systems produce less thrust than NERVA but are a step towards using nuclear technology in space and physically experimenting with propulsion systems that one day may be used on spacecraft heading to distant objects in the solar system. It is just a matter of time - and increasing economic competition between nations — until we will see such systems being used in transporting equipment and humans to Mars in order to make humanity a multiplanetary species.

SCIENCE

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Summer

Solution, page 3

	8	3	9					2
6					8			9
	9				4			
9	1			3		8		4
		2				3		
3		7		8			6	1
			8				1	
1			5					8
7					6	2	4	

Instructions: Fill in the grid so that each column, row, and 3 by 3 grid contains exactly one of each of the digits 1 through 9.

Vacation

Solution, page 3

		4		9	2		5	3
	6	5						
7		1		6		2		5
						6	1	
8	4		9	2		5		
				8			2	
5					3		4	9

Instructions: Fill in the grid so that each column, row, and 3 by 3 grid contains exactly one of each of the digits 1 through 9.

Final Charges by Mark McClain Solution, page 3

- **ACROSS**
- 1 Oxygen or hydrogen
- 4 "Gotcha, man!"
- 9 Inexpensive mags of old
- 14 Many an Austrian mountain
- 15 Limitless amount (of) 16 Prepare for a bout
- 17 Capitalize on
- 18 Legendary Wild West showman
- 20 Stare at
- 22 Make very happy
- 23 No longer in style 24 Frozen reindeer
- 25 Document executed under oath
- 32 Made sharper
- 33 "Get a move on!"
- 34 W. Hemisphere alliance
- 36 Tiny amount
- 37 Jim who draws Garfield
- 38 DVD or CD
- 39 "Without further ___
- 40 Audit a class
- 41 Bean in burritos

- 42 Trooper's handout
- 45 Movers' vehicles
- 46 Become ripe
- 47 San Antonio landmark
- 49 By December 31
- 54 Loan officer's request
- 56 Early afternoon hour
- 57 Layers of tissues
- 58 New __, India
- 59 Capture
- 60 Cook meat in an oven
- 61 Saw to a seat
- 62 Maritime assent

DOWN

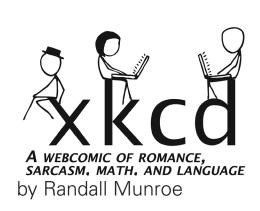
- 1 France, to Caesar
- 2 In addition
- 3 Architect's detail 4 Headed toward the city
- 5 Horses, to riders
- 6 Lift with effort
- 7 Facts and figures
- 8 Smartphone forerunner:
- 9 Ancient Egyptian astronomer

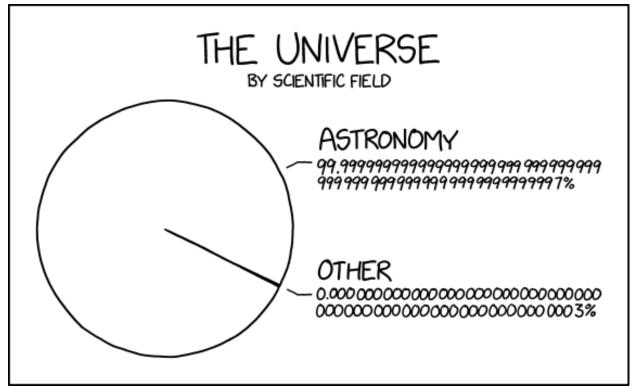
- 10 Elegant and refined
- 11 Milk: Fr.
- 12 Messy stack
- 13 Satirical NBC series
- 19 Arms of slot machines
- 21 Seoul, South __
- 24 Part of a yo-yo
- 25 Branch of Islam
- 26 Forested areas 27 Leading the pack
- 28 "I meant to say . . ."
- 29 Coq __ (chicken with wine)
- 30 Printer problem
- 31 Aesthetic discernment
- 35 Inverness native
- 37 Failed to
- 38 Problematical
- 40 Shoreline fog
- 41 Football, informally 43 Gets out of
- 44 Meditative exercise
- 47 Singer Guthrie
- 48 Star Wars princess
- 49 You, in Shakespeare's
- plays
- 18 17 25 | 26 | 27 28 | 29 36 39 45 46 49 50 51 52 53 56 58 59 62
- 50 Conducted, as a meeting
- 51 Frequent Italian erupter
- 52 Not at home
- 53 Church choir attire
- 54 EMT's skill
- 55 450, in Roman numerals

11

12 13

[2640] The Universe by Scientific Field





Internship

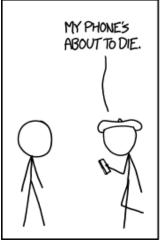
Solution, page 3

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8				1			3	
		6			4	8		1
		1		8		7		4
9				4				2
2		7		9		3		
6		3	4			1		
	2			3				6
4					1		7	

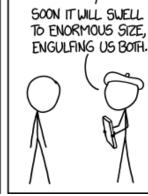
Instructions: Fill in the grid so that each column, row, and 3 by 3 grid contains exactly one of each of the digits 1 through 9.

A WEBCOMIC OF ROMANCE, SARCASM. MATH. AND LANGUAGE by Randall Munroe

[1422] My Phone is Dying

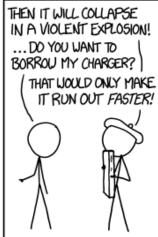






AS IT CONSUMES IT'S BATTERY,

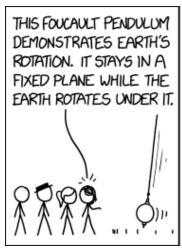
IT HEATS UP AND EXPANDS.



bager.

A WEBCOMIC OF ROMANCE, SARCASM. MATH. AND LANGUAGE by Randall Munroe

[2201] Foucault Pendulum







THE EARTH'S ROTATION WAS BRIEFLY HALTED TODAY UNTIL GEOPHYSICISTS WRESTLED THE INTRUDER TO THE GROUND...

BREAKING NEWS

Reference Systems Service.

Trust me, you don't want to get on the wrong side of the paramilitary enforcement arm of the International Earth Rotation and

Research

Solution, page 3

5					2			4
		2					7	
			7	5		2		
	3	1	6			9		7
	7		5	9	3		8	
6		9			1	4	3	
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	2					3		
1			2					9